MICRO-PASSAGE ELEMENT USED FOR FLUID ANALYSIS

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a fluid passage used for an instrumental analysis, which is made by using a glass substrate.

[0002] Generally, a fluid passage used for an instrumental analysis is made of a micro-tube of glass, stainless steel, or the like.

[0003] Such a micro-tube is used in practice usually in a length of about 50 cm, in order to enhance the analytical performance; however when used, the micro-tube is coiled in circle, and therefore it is very difficult to miniaturize the tube.

[0004] Conventionally, there has been a report on a technique for miniaturizing a micro-tube with use of a semiconductor manufacturing method, in which a very fine micro-groove is made in a silicon substrate or the like. However, the conventional technique entails the following drawback. That is, when a silicon substrate is used for a capillary electrophoresis in which substances are separated by applying a high voltage thereto, a current leakage occurs in the silicon substrate, and therefore a high voltage cannot be applied.

[0005] In order to avoid such a drawback, there has been provided a technique of making a fluid passage as an instrumental analysis fluid passage in which no leakage of current occurs, by processing a fine micro-groove in a glass substrate of an insulating material.

[0006] For example, "Micromachining of Capillary Electrophoresis Injectors and Separators on Glass Chips and Evaluation of Flow at Capillary Intersections" (Anal. Chem. 1994, 66, page 177 to 184) discusses a fluid passage made by processing a groove in a borosilicate glass substrate and then welding the borosilicate glass substrate by heating.

[0007] The process of the groove is carried out in the following manner. That is, a metal deposition film is formed on a borosilicate glass substrate, and the metal film is patterned by the photolithography. Then, with use of the metal film as a mask, the borosilicate glass substrate is immersed into a solution in which hydrofluoric acid is mixed, so as to carry out etching for making a U-shape groove. Further, a flat borosilicate glass substrate is stacked on thus groove-processed borosilicate glass substrate, and the resultant is heated up to 700° C. for welding.

[0008] Apart from the above, "A New Fabrication Method of Borosilicate Glass Capillary Tubes with Lateral Inlets and Outlets" (Analytical Methods & Instrumentation, Special Issue μTAS '96 p 214) discusses a technique of forming a fluid passage by making a groove in a borosilicate glass substrate, and then joining thus processed borosilicate glass substrate and another flat borosilicate glass substrate together by an anodic joining method.

[0009] According to this technique, a groove is processed as follows. That is, a poly-Si thin film is grown on a borosilicate glass substrate by a low pressure chemical vapor deposition (LPCVD), and the polysilicon thin film is patterned with use of the photolithography. Then, with use of the polysilicon thin film as a mask, the borosilicate glass substrate is immersed into a solution in which hydrofluoric acid is mixed, so as to carry out etching for making a groove.

[0010] Then, in the anodic joining method, two borosilicate glass substrates are joined together with heat while applying a voltage between the polysilicon thin film on one borosilicate glass substrate, and the other polysilicon thin film.

[0011] In the general case of analyzing a fluid by separating substances from each other, using a fluid passage for instrumental analysis, a separated substance is detected by means of an optical manner.

[0012] However, in both of the above-described conventional techniques, borosilicate glass is used as a substrate for making a fluid passage for instrumental analysis, and therefore the passage absorbs the light of an ultraviolet wavelength region, thus making it impossible to perform an optical detection fir a short wavelength region.

BRIEF SUMMARY OF THE INVENTION

[0013] The object of the present invention is to provide a fine micro fluid passage element having a fluid passage for instrumental analysis, which is capable of performing an optical detection over a range from ultraviolet to visible wavelength, and being easily miniaturized.

[0014] According to the present invention, there is provided a micro fluid passage element comprising: a laminated film formed by interposing an alkali-ion containing glass layer between a pair of silicon layers from both surfaces; and a pair of quartz glass substrates formed on both surfaces of the laminated film as to be joined together as an integral body in a manner that surfaces of the pair of quartz glass substrates, which are located on a joining side, face to each other, wherein the micro fluid passage element has a piecing hole serving as a fluid passage, formed along the laminated film and a direction of a surface of at least one of the pair of the quartz glass substrate, made at an arbitrary depth. There is further provided such a micro fluid passage element, wherein a light reflection layer or a light absorption layer having a plurality of light transmitting openings in the surfaces of the pair quartz glass substrates, which are located on the non-joining side, at positions which sandwich the fluid pass, is formed on the non-joining surface.

[0015] Additional object and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The object and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0016] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

[0017] **FIG. 1** is a diagram showing a schematic view of the structure of a micro-fluid passage element according to the first embodiment of the present invention;